

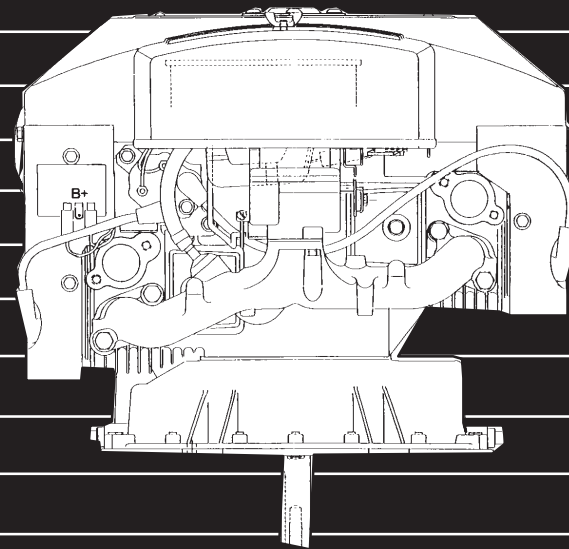


Engine

Operator's Manual

P218V
P220V

Performer Series



Emissions Supplement: 900-1021

Date: 07-2000

Insert with-

Manual Number & Date: See Table 1

Models: See Table 1

Purpose: This supplement for the Operator's Manuals specified in Table 1 clarifies how compliance with engine emissions regulations, including U. S. EPA Phase 2 and California Air Resources Board regulations for Model Year 2000 onwards, is presented on genset and engine nameplates (Figures 1 and 2). This sheet is to be bound in the genset or engine manual behind the front cover and in front of earlier Supplements, if any.

For engines of less than 225 cc displacement, Category C = 125 hrs, B = 250 hrs, A = 500 hrs. For engines of 225 cc and greater displacement, Category C = 250 hrs, B = 500 hrs, A = 1000 hrs.

TABLE 1. MANUALS AFFECTED BY SUPPLEMENT

Manual No.	Date	Genset Models
965-0138	5/97	BGM / NHM
965-0175	7/97	BGD / NHD
965-0176	7/97	BGE / NHE
981-0153	7/97	KV
981-0158	6/99	KVC
981-0159	5/00	KY
981-0160	7/99	MKY
983-0101	5/00	HGJAA / HGJAB / HGJAC
Manual No.	Date	Engine Models
965-0163	10/95	Miller P216 / P218 / P220 / P224
965-0174	10/97	E124V Floorcare
965-0178	7/97	E125V / E140V
965-0179	7/97	E125H / E140H
965-0180	7/97	P218V / P220V
965-0182B	-	P216 / P218 / P220 / P224
965-0183	-	P248V Floorcare

Nameplate Information: See the Operator's Manual for the location of the actual nameplate on the genset or engine. Figures 1 and 2 illustrate where the information regarding compliance with U. S. EPA and California Air Resources Board regulations on the nameplate. The appropriate figure in this supplement supercedes the nameplate illustration in Figure 1 in the genset or engine manual in which the supplement is bound.

Federal Emissions Compliance Period: The Federal Emissions Compliance Period referred to on the nameplate indicates the number of operating hours for which the engine has been shown to meet Federal emissions requirements.


IMPORTANT ENGINE INFORMATION		
		
CUMMINS POWER GENERATION 1400 73rd Ave. NE Minneapolis, MN 55432 Made in U.S.A.		
Model No:		
S/N:		Pf:
AC Volts:	kVA:	kW:
Amps:	Pf:	RPM:
Fuel:	Hz:	Bat:
Options:	Wiring Diagram:	
Insulation - NEMA Class F Ambient 40°C		
[The engine family designation, engine displacement, statement of compliance with the applicable EPA and / or California emissions regulations, including the compliance period or category, appear in this block on the actual nameplate on the genset.]		

FIGURE 1. TYPICAL GENSET NAMEPLATE


IMPORTANT ENGINE INFORMATION	
	
ONAN CORPORATION 1400 73rd Ave. NE Minneapolis, MN 55432 Made in Canada	
Engine Model:	
S/N:	
[The engine family designation, engine displacement, statement of compliance with the applicable EPA and / or California emissions regulations, including the compliance period or category, appear in this block on the actual nameplate on the engine.]	

FIGURE 2. TYPICAL ENGINE NAMEPLATE

Safety Precautions

Before operating the engine, read this manual and become familiar with it and the equipment. **Safe and efficient operation can be achieved only if the equipment is properly operated and maintained.**

The following symbols, found throughout this manual, alert you to potentially dangerous conditions to the operator, service personnel, or the equipment.

⚠ DANGER *This symbol warns of immediate hazards which will result in severe personal injury or death.*

⚠ WARNING *This symbol refers to a hazard or unsafe practice which can result in severe personal injury or death.*

⚠ CAUTION *This symbol refers to a hazard or unsafe practice which can result in personal injury or product or property damage.*

Fuels, electrical equipment, batteries, exhaust gases and moving parts present potential hazards that can result in severe personal injury. Take care in following these recommended procedures. All local, state and federal codes should be consulted and complied with.

⚠ WARNING *This engine is not designed or intended for use in any type of aircraft. Use of this engine in aircraft can result in engine failure and cause severe personal injury or death.*

GENERAL

- Provide appropriate fire extinguishers and install them in convenient locations. Use an extinguisher rated ABC by NFPA.
- Make sure that all fasteners on the engine are secure and accurately torqued. Keep guards in position over fans, driving belts, etc.
- If it is necessary to make adjustments while the engine is running, use extreme caution when close to hot exhausts, moving parts, etc.
- Used engine oils have been identified by some state and federal agencies as causing cancer or reproductive toxicity. When checking or changing engine oil, take care not to ingest, breathe the fumes, or contact used oil.
- Do not work on this equipment when mentally or physically fatigued, or after consuming any alcohol or drug that makes the operation of equipment unsafe.

BATTERIES

- Before starting work on the engine, disconnect batteries to prevent inadvertent starting of the engine. Disconnect negative (-) cable first.
- DO NOT SMOKE while servicing batteries. Lead acid batteries give off a highly explosive hydrogen gas which can be ignited by flame, electrical arcing or by smoking.
- Verify battery polarity before connecting battery cables. Connect negative (-) cable last.

PROTECT AGAINST MOVING PARTS

- Do not wear loose clothing in the vicinity of moving parts, such as PTO shafts, flywheels, blowers, couplings, fans, belts, etc.
- Keep your hands away from moving parts.

FUEL SYSTEM

- DO NOT fill fuel tanks while engine is running.
- DO NOT smoke or use an open flame in the vicinity of the engine or fuel tank. Internal combustion engine fuels are highly flammable.
- Fuel line must be of steel piping, adequately secured, and free from leaks. Piping at the engine should be approved flexible line. Do not use copper piping for flexible lines as copper will work harden and become brittle enough to break.
- Be sure all fuel supplies have a positive shutoff valve.
- Benzene and lead, found in some gasoline, have been identified by some state and federal agencies as causing cancer or reproductive toxicity. When checking, draining or adding gasoline, take care not to ingest, breathe the fumes, or contact gasoline.

EXHAUST SYSTEM

- Exhaust products of any internal combustion engine are toxic and can cause injury, or death if inhaled. When operating the engine in a confined area, make sure the ventilation system is operating properly.
- DO NOT use exhaust gases to heat a compartment.
- Make sure that your exhaust system is free of leaks. Make sure that exhaust manifolds are secure and are not warped by bolts unevenly torqued.

EXHAUST GAS IS DEADLY!

Exhaust gases contain carbon monoxide, a poisonous gas that can cause unconsciousness and death. It is an odorless and colorless gas formed during combustion of hydrocarbon fuels. Symptoms of carbon monoxide poisoning are:

- Dizziness
- Headache
- Weakness and Sleepiness
- Vomiting
- Muscular Twitching
- Throbbing in Temples

If you experience any of these symptoms, get out into fresh air immediately, shut down the unit and do not use it until it has been inspected.

The best protection against carbon monoxide inhalation is proper installation and regular, frequent inspections of the complete exhaust system. If you notice a change in the sound or appearance of exhaust system, shut the unit down immediately and have it inspected and repaired at once by a competent mechanic.

KEEP THE UNIT AND SURROUNDING AREA CLEAN

- Make sure that oily rags are not left on or near the engine.
- Remove all unnecessary grease and oil from the unit. Accumulated grease and oil can cause overheating and subsequent engine damage and present a potential fire hazard.

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⚠ WARNING *Improper service or replacement of parts can result in severe personal injury and equipment damage. service personnel must be qualified to perform electrical and/or mechanical service.*

CALIFORNIA PROPOSITION 65 WARNING

Engine exhaust from this product contains chemicals known to the State of California to cause cancer, birth defects, and other reproductive harm.

Introduction

ABOUT THIS MANUAL

This manual covers the operation and maintenance of the vertical-shaft Performer Series of engines. Each operator of the power equipment should study this engine manual carefully and observe all of its instructions and precautions. Proper use and periodic maintenance are responsibilities of the operator(s) and are essential for top performance.

MODEL IDENTIFICATION

Whenever contacting an Onan dealer or distributor for information, parts or service, always provide the model number and the serial number marked on the nameplate of the engine. Figure 1 illustrates a typical engine nameplate and Figure 2 the location of the nameplate on the engine.

Genuine Onan replacement parts obtained from an Onan dealer or distributor are recommended.

IMPORTANT ENGINE INFORMATION	
	ONAN CORPORATION 1400 73rd Ave. NE Minneapolis, MN 55432 MADE IN U.S.A.
	Engine Model: P220V-I/11264F
S/N: L951234567	99-2453
REFER TO OPERATOR'S MANUAL FOR MAINTENANCE SPECIFICATIONS AND ADJUSTMENTS.	
THIS ENGINE MEETS U.S. EPA PH1 AND 1995-1998 CALIFORNIA EMISSIONS REGULATIONS FOR ULGE ENGINES.	
SN5782U1G2RA	782cc
UNLEADED GASOLINE ONLY	

FIGURE 1. TYPICAL ENGINE NAMEPLATE

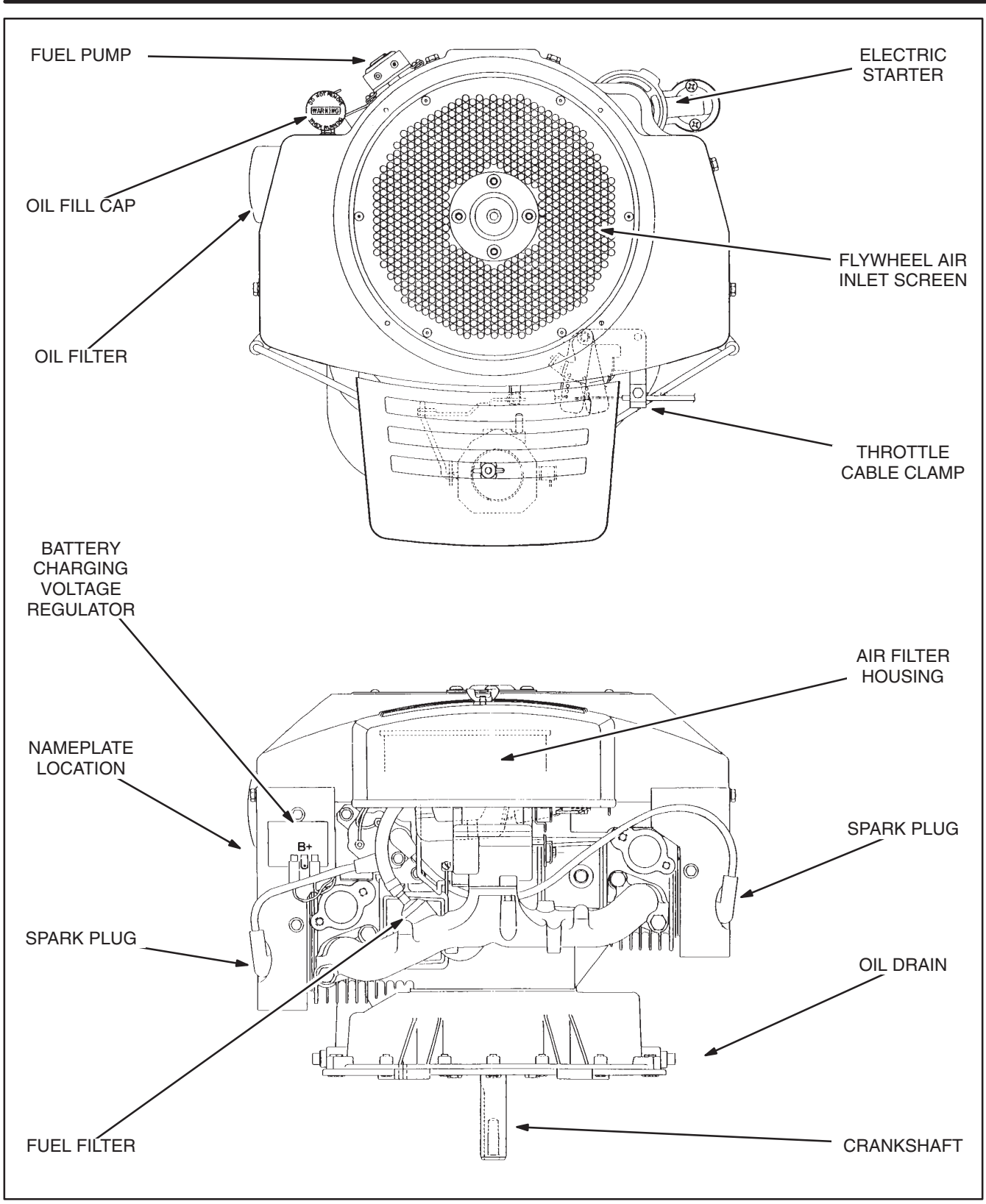


FIGURE 2. TYPICAL ENGINE CONFIGURATION

FUEL RECOMMENDATIONS

Use clean, fresh unleaded gasoline having a minimum octane rating (Anti-Knock Index) of 87.

During some times of the year only mandated “oxygenated” gasolines may be available. These are acceptable for use, but not preferable. Leaded gasoline may be used but will result in the extra maintenance required for removing combustion chamber and spark plug deposits. Do not use gasoline or gasoline additives (de-icers) containing methanol because methanol can be corrosive to fuel system components.

⚠ CAUTION *Do not use gasoline or gasoline additives containing methanol because methanol can be corrosive to fuel system components.*

Avoid using highly leaded gasolines and lead additives because of the extra engine maintenance that will be required.

⚠ WARNING *Gasoline is highly flammable and can cause severe personal injury or death. Do not smoke if you smell gasoline or are near fuel tanks or gasoline-burning equipment or are in an area sharing ventilation with such equipment. Keep flames, sparks, pilot lights, electrical arcs and arc-producing equipment and all other sources of ignition well away.*

ENGINE OIL RECOMMENDATIONS

Use premium quality motor oil. Look for the API (American Petroleum Institute) classification and use Class SG or SH oil (also SG/CD, SG/CE, SH/CD or SH/CE). Also look for the SAE (Society of Automotive Engineers) viscosity grade. Referring to Table 1, choose the viscosity grade appropriate for the ambient temperatures expected during the period of time until the next scheduled oil change.

Single-grade SAE 30 oil is preferable when temperatures are consistently above freezing. Multigrade oils are better when wide temperature variations are expected.

TABLE 1. OIL VISCOSITY VS. TEMPERATURE

EXPECTED AMBIENT TEMPERATURES	SAE VISCOSITY GRADE
32° F (0° C) and higher	30
10° F to 100° F (-12° C to 38° C)	15W-40 (OnaMax)
0° F to 80° F (-18° C to 27° C)	10W-30 10W-40
-20° F to 50° F (-28° C to 10° C)	5W-30

STARTING BATTERIES

The engine is equipped with a 12 volt electric starter. Prompt starting requires sufficient battery capacity and battery cable size. Neither cranking performance nor starter service life will be satisfactory with an undersized battery.

Regular, monthly maintenance of batteries may be required. See *Periodic Maintenance* and any instructions available from the equipment or battery manufacturer. It should be noted that as long as the equipment is operated regularly, the automatic battery recharging system on the engine should be able to maintain battery charge. See OUT-OF-SERVICE PROTECTION under *Operation* regarding battery care during storage for prolonged periods.

EXHAUST SYSTEM

EXHAUST GAS IS DEADLY! Mobile engine-powered equipment must never be operated inside buildings or other enclosed spaces without ample fresh air ventilation.

Stationary engine-powered equipment installed inside buildings or other enclosed spaces must be equipped with a leak-free exhaust system that carries all exhaust gases to the outside, well away from all windows, doors, vents and other openings into the building or enclosure.

It is the responsibility of the equipment operator(s) to check for exhaust leaks on a daily basis and to have all leaks repaired before continuing to operate the equipment.

⚠ WARNING EXHAUST GAS IS DEADLY!

Exhaust gases contain carbon monoxide, an odorless and colorless gas. Carbon monoxide is poisonous and can cause unconsciousness and death. Symptoms of carbon monoxide poisoning include:

- *Dizziness*
- *Nausea*
- *Headache*
- *Weakness and Sleepiness*
- *Throbbing in Temples*
- *Muscular Twitching*
- *Vomiting*
- *Inability to Think Coherently*

IF YOU OR ANYONE ELSE EXPERIENCE ANY OF THESE SYMPTOMS, GET OUT INTO THE FRESH AIR IMMEDIATELY. If symptoms persist, seek medical attention. Shut down the engine and do not operate it until it has been inspected and repaired.

Make certain the exhaust system is properly installed. Inspect it every time the engine is started and after every eight hours of continuous operation.

PRE-START CHECKS

Before the first start of the day and after every eight hours of operation perform the maintenance instructed in DAILY (8 HOUR) MAINTENANCE under *Periodic Maintenance*. Keep a log of maintenance and the hours run and perform any maintenance that may be due. Also, if the equipment has been in storage, return the engine to service as instructed under RETURNING THE ENGINE TO SERVICE in this section.

Always follow the equipment manufacturer's operating instructions and observe all precautions when operating power equipment.

⚠ WARNING *Moving parts can cause severe personal injury or death. Hot exhaust parts can cause severe burns. Stay clear of hot or moving parts. Make sure all protective shields and guards are secure in place before starting up the equipment.*

STARTING

1. Check the oil level if this is the first start of the day and add oil as necessary.

⚠ CAUTION *Starting the engine without oil will cause severe engine damage. Always keep the engine oil level between the Full and Add marks on the dipstick.*

2. Fill the fuel tank, if necessary, and open any fuel line shutoff valve.
3. Release the clutch if the engine is so equipped.
4. Unless the engine is equipped with an automatic choke, pull the choke knob out to its full-choke position. On equipment with a solenoid operated choke, push the switch to its choke position.
Note: Try starting without the choke in warm weather or when the engine is warm.
5. Push the throttle knob or lever to the middle of its speed range.
6. Turn the ignition-start switch to its start position and hold it there until the engine starts. Do not crank for more than 30 seconds at a time and wait at least one minute between tries when cranking. See *Troubleshooting* if the engine does not start after several tries.
7. After the engine starts, unless it is equipped with an automatic choke, keep your hand on the choke knob and slowly push it in to the full-open choke position, pulling back if necessary to keep the engine running smoothly. The colder the weather the longer it will take the engine to start running smoothly with the choke fully open. Do not operate the equipment until the engine has warmed up sufficiently to run smoothly with the choke fully open.

ENGINE BREAK-IN

Engine break-in as a result of proper care during the first hours of operation of a new or rebuilt engine results in the ideal fitting of all internal moving metal parts, which is essential for top engine performance. For controlled engine break-in:

1. Operate the equipment as it is intended to be operated. However, for the first 3 hours, if possible, operate the equipment at about half the available engine power, occasionally operating at full engine power for brief periods. Also, if possible, avoid prolonged low-speed, low-power operation during engine break-in.
2. Proper engine oil is especially critical during break-in because of the higher engine temperatures that can be expected. See **RECOMMENDED ENGINE OIL** in *Introduction*. Change the oil if it is not appropriate for the ambient temperatures during the break-in period. See Table 1.
3. Check the oil level twice a day or after every 4 hours of operation during the first 24 hours of operation.
4. Change the oil and oil filter after the first 24 hours of operation.

OPERATION IN DUSTY CONDITIONS

1. Keep the engine cooling fins and flywheel air inlet screen clean.
2. Perform air cleaner maintenance more often than normal—as required. See Table 2.
3. Change the engine oil and oil filter more often than normal. See Table 2.

OPERATION IN HOT WEATHER

Pay particular attention to the following items when operating the engine in temperatures above 100° F (38° C):

1. Keep the flywheel air inlet screen and cylinder cooling fins clean. See to it that nothing obstructs air flow to and from the engine.
2. Check the oil level more frequently.
3. Change the oil and oil filter more often than normal. See Table 2.
4. Make sure the engine oil viscosity is appropriate for the ambient temperatures and change the oil if necessary. See Table 1.

OPERATION IN COLD WEATHER

Pay particular attention to the following items when operating the engine in temperatures below freezing:

1. Make sure the engine oil viscosity is appropriate for the ambient temperatures and change the oil if necessary. See Table 1. If the temperature drops before you have the chance to change the oil, warm up the engine by moving the equipment into a heated space before attempting to start the engine or change oil.

⚠ WARNING **EXHAUST GAS IS DEADLY!**
Never operate mobile engine-powered equipment indoors without ample fresh air ventilation.

2. Use fresh fuel and fill the fuel tank after each day's use to reduce problems with moisture condensation.
3. Keep the battery in a well-charged condition.
4. After each use push the equipment throttle knob or lever to the middle of its speed range so that if ice forms on the linkage during storage it will be easier to start the engine.

OUT-OF-SERVICE PROTECTION

Protect an engine that will be out of service for more than 30 days as follows:

1. Run the engine until it reaches normal operating temperature, shut off the fuel supply and let the engine run until it stops. Also, if the equipment will not be operated for more than 120 days, add a fuel preservative (OnaFresh™) to the equipment fuel tank. Follow the instructions on the container label. Unless a preservative (stabilizer) is added, the gasoline will deteriorate causing fuel system corrosion, gum formation and varnish-like deposits which can lead to hard starting and rough operation.

⚠WARNING *Gasoline preservatives (stabilizers) are toxic. Follow the instructions on the container label. Avoid skin contact. Wash your hands with soap and water after dispensing the fluid.*

2. Drain the oil from the engine while it is still warm. Refill with fresh oil and attach a tag stating the viscosity of the oil used.
3. Remove the spark plugs and squirt 1 ounce (2 tablespoons or 28 grams) of rust inhibitor or SAE 30 oil into each cylinder. Crank the engine over a few times and reinstall the spark plugs.
4. Perform air cleaner maintenance as instructed in *Periodic Maintenance*.
5. Clean the governor linkage and wrap it with a clean cloth for protection.

6. Plug the exhaust outlet to prevent moisture, dirt, bugs, etc. from entering.
7. Provide a suitable cover for the entire unit.
8. If so equipped, disconnect the battery (negative [-] cable first) and follow the battery or equipment manufacturer's storage instructions.

RETURNING THE ENGINE TO SERVICE

1. Remove the cover and all protective wrapping and the plug from the exhaust outlet.
2. Check the tag on the oil base. Change the oil if the viscosity is not appropriate for the expected ambient temperatures. See Table 1.
3. Check the fuel filter and fuel lines to make sure they are secure and have no cracks or leaks.
4. Check to see that the choke, throttle and governor linkages move freely.
5. If so equipped, clean and check the battery according to the battery or equipment manufacturer's instructions and connect the battery cables (positive [+] cable first).
6. Start the engine. The initial startup may be slow and there may be smoke and rough operation for a few minutes until the oil in the cylinder burns off. If the engine does not start, clean or replace the spark plugs as they may have been fouled by the oil added to the cylinder when the equipment was stored.

Periodic Maintenance

Periodic maintenance is essential for top engine performance. Use Table 2 as a guide for normal periodic maintenance. Under hot or dusty operating conditions some maintenance operations should be performed more frequently, as indicated by the footnotes in the table. Keep a log of maintenance performed and the hours run. Recording maintenance will help you keep it regular and provide a ba-

sis for supporting warranty claims.

Maintenance, replacement or repair of emission control devices and systems may be performed by any engine repair establishment or individual. However, warranty work must be completed by an authorized Onan dealer or distributor.

TABLE 2. PERIODIC ENGINE MAINTENANCE SCHEDULE

MAINTENANCE OPERATION	MAINTENANCE FREQUENCY						
	Every Day or Every 8 Hours	Every 50 Hours	Every Month	Every 100 Hours	Every 200 Hours	Every 500 Hours	Every 1,000 Hours
Inspect Engine	• ¹						
Check Oil Level	•						
Clean Air Cleaner Foam Wrapper		• ³					
Clean Cylinder Cooling Fins		• ³					
Check Starting Battery			• ⁵				
Change Engine Oil		• ^{2, 3, 4}					
Change Engine Oil Filter				• ^{2, 3, 4}			
Replace Fuel Filter					•		
Replace Air Cleaner Element					• ³		
Adjust Engine Valve Clearance					• ⁶		
Replace Spark Plugs						•	
Clean Cylinder Heads of Deposits							• ^{6,7}

1 Check for oil, fuel and exhaust leaks, loose parts and unusual noises and vibrations.
 2 Perform after the first 24 hours of operation as a part of engine break-in.
 3 Perform more often when operating in dusty conditions.
 4 Perform more often when operating in hot conditions.
 5 See instructions for battery care provided by the equipment or battery manufacturer.
 6 Must be performed by a qualified mechanic according to the engine Service Manual.
 7 Clean more often when using leaded fuel or running the engine continuously under light load. Onan 4C carburetor and combustion cleaner is recommended every 200 hours of operation.

DAILY (8 HOUR) MAINTENANCE

The operator should check the following before the first start of the day and after every eight hours of operation:

1. Inspect fuel lines and fittings for leaks. Repair leaks immediately.
2. Look and listen for exhaust system leaks while the engine is running. Look for cracks and severe rusting in the muffler and tailpipe. Have all leaks repaired before continuing to operate the equipment.

⚠ WARNING *Hot exhaust parts can cause severe burns. Allow the engine time to cool before servicing the exhaust system.*

3. Check the engine for dirt and debris and clean the flywheel air inlet screen and cylinder cooling fins as necessary.

⚠ CAUTION *A clogged flywheel air inlet screen or dirty cooling fins can cause overheating and engine damage. Keep the cooling fins and air inlet screen clean.*

4. Check the engine oil level. The equipment must be parked on a level surface and the engine stopped. To get an accurate reading, wait a minute or so to allow the oil to settle in the crankcase if the engine has been running.

⚠ WARNING *Crankcase pressure can blow hot engine oil out the fill tube causing severe burns. Always stop the engine before removing the oil fill cap.*

Turn the oil fill cap (Figure 3) counterclockwise and then lift it from the fill tube. Wipe the dipstick clean and push it back into the oil fill tube until the cap seats and then withdraw it to check the oil level.

If the oil level is low, add API Class SG or SH oil (also SG/CD, SG/CE, SH/CD or SH/CE) hav-

ing an SAE viscosity grade appropriate for the expected temperatures, as indicated by Table 1.

DO NOT FILL TO A LEVEL ABOVE THE FULL MARK ON THE DIPSTICK. Drain the excess oil if too much has been added.

⚠ CAUTION *Too much oil can cause high oil consumption, high operating temperatures and oil foaming. Too little oil can cause severe engine damage. Keep the oil level between the Full and Add marks on the dipstick.*

Reinstall the dipstick and cap after checking or adding oil, turning it clockwise until it is secure.

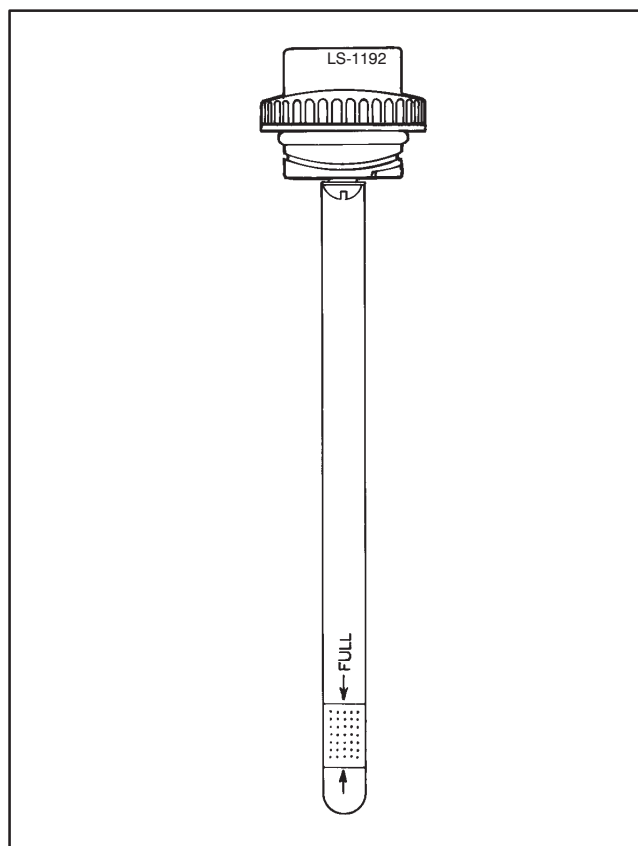


FIGURE 3. OIL FILL CAP AND DIPSTICK

ENGINE OIL AND FILTER CHANGE

⚠WARNING *State and federal agencies have determined that contact with used engine oil can cause cancer or reproductive toxicity. Take care to limit skin contact and breathing of vapors as much as possible. Use rubber gloves and wash exposed skin.*

Refer to Table 2 for scheduled oil change and filter replacement. See Figure 2 on page 3 for oil filter and oil drain locations.

1. Run the engine until it is warm. Stop the engine and disconnect the spark plug and, if so equipped, the battery (negative [-] cable).

⚠WARNING *Accidental starting of the engine can result in severe personal injury or death. Always disconnect the spark plug and the battery (negative [-] cable) before changing oil.*

2. Remove the oil fill cap.

⚠WARNING *Crankcase pressure can blow hot engine oil out the fill opening causing severe burns. Always stop the genset before removing the oil fill cap.*

3. Place a pan under the oil drain opening and remove the oil drain plug. Reinstall the plug securely after the oil has drained completely.
4. Spin off the oil filter canister, drain the oil and discard the filter according to local regulations.

5. Thoroughly wipe off the filter mounting surface.
6. Make sure the gasket is in place on the filter canister and apply a thin film of oil to the gasket.
7. Spin on the new filter canister by hand until the gasket just touches the mounting pad and then turn it an additional 1/2 to 3/4 turn. Do not overtighten.
8. Refill with API Class SG or SH oil (also SG/CD, SG/CE, SH/CD or SH/CE) having an SAE viscosity grade appropriate for the expected temperatures, as indicated by Table 1. See *Specifications* for the oil capacity.

DO NOT FILL TO A LEVEL ABOVE THE FULL MARK ON THE DIPSTICK. Drain the excess oil if too much has been added.

⚠CAUTION *Too much oil can cause high oil consumption, high operating temperatures and oil foaming. Too little oil can cause severe engine damage. Keep the oil level between the Full and Add marks on the dipstick.*

9. Reconnect the spark plug and battery.
10. Start the engine and run it for a short time while checking for oil leaks around the drain plug and oil filter. Do not overtighten: tighten only as necessary to eliminate leaks.
11. Used oil is harmful to the environment. Pour the used oil into a sealed container and deliver it to the nearest recycling center.

AIR CLEANER MAINTENANCE

Refer to Table 2 for scheduled foam wrapper maintenance and air cleaner element replacement. See Figure 4.

Foam Wrapper Maintenance

When performing maintenance on the foam wrapper only, do not remove the inner air cleaner cover. Remove and wash the foam wrapper in water and detergent. Squeeze the foam wrapper dry like a sponge. Rinse with clean water and allow it to dry. Coat the wrapper evenly with one tablespoon (14 grams) of SAE 30 engine oil. Knead the oil into the wrapper and wring out the excess oil.

Failure to adequately wring out excess oil from the wrapper may cause a drop in engine power due to a restriction of inlet air.

Install the foam wrapper over the paper air cleaner element by stretching it over the inner cover. Com-

pletely cover all exposed paper pleats on the air cleaner paper element. Replace the foam wrapper when it becomes torn or stretched.

Air Cleaner Element Replacement

To keep anything from entering the carburetor and engine while the air cleaner element is off, pull the choke knob to the full-choke position to close the choke plate in the carburetor. Remove the outer cover and wipe away loose dust and debris from the air cleaner assembly. Remove the inner air cleaner mounting nut and cover. Remove the air filter paper element and foam wrapper from the engine. Wipe off dust and debris from the air cleaner base.

Install the new paper element and secure it with the inner cover and mounting nut. Reinstall the foam wrapper and outer cover. Make sure to reconnect the the crankcase breather tube.

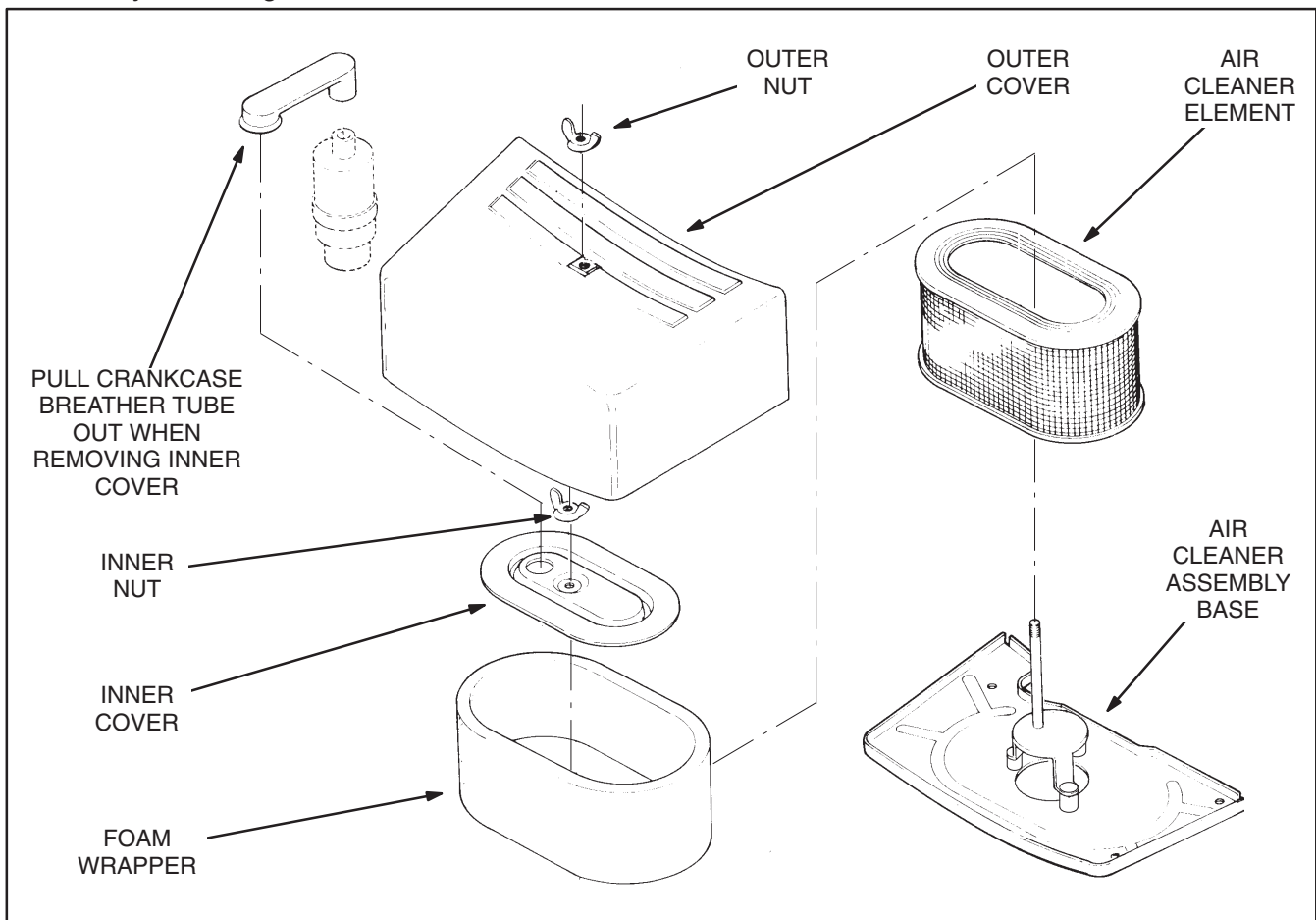


FIGURE 4. AIR CLEANER ASSEMBLY

COOLING SYSTEM MAINTENANCE

Refer to Table 2 for scheduled cleaning of the cylinder cooling fins.

Use compressed air or a pressure washer to clean the cylinder cooling fins. Take the following precautions.

1. Wear safety glasses.

⚠WARNING *Always wear safety glasses when using compressed air or a pressure washer to avoid severe eye damage.*

2. Let the engine cool, especially when using a pressure washer. The temperature stresses caused by cleaning a hot engine can crack the cylinder.
3. Observe all of the manufacturer's instructions and precautions when using a pressure washer.

FUEL FILTER REPLACEMENT

Refer to Table 2 for scheduled fuel filter replacement and Figure 2 for the location of the fuel filter (if so equipped). Also refer to the equipment Operator's Manual regarding any supplemental fuel filters that may have been provided and the recommended frequency for their replacement.

Take care not to spill fuel when disconnecting the fuel line from the filter. Allow the engine to cool before disconnecting the fuel line so that it cannot ignite any fuel that may be spilled. Close any shutoff valve that may be provided in the fuel line. If the filter is of the in-line type, it is usually removable by loosening the inlet and outlet hose clamps.

⚠WARNING *Gasoline is highly flammable and can cause severe personal injury or death.*

Let the engine cool and close any fuel line shutoff valve before disconnecting the fuel line from the filter.

Do not smoke if you smell gasoline or are near fuel tanks or gasoline-burning equipment or are in an area sharing ventilation with such equipment. Keep flames, sparks, pilot lights, electrical arcs and arc-producing equipment and all other sources of ignition well away.

SPARK PLUG REPLACEMENT

Refer to Table 2 for scheduled spark plug replacement and *Specifications* for gap specifications.

To prevent crossthreading the spark plug always thread it in by hand until it seats. Then turn it with a wrench an additional 1/16 turn (22-1/2°). If you have a torque wrench, tighten the spark plugs to 11 lbs-ft (14 N-m).

Adjustments

CARBURETOR ADJUSTMENTS

These engines have precision-manufactured carburetors which are not adjustable.

RECONNECTING AND RECLAMPING THE CHOKE CABLE (MANUAL CHOKE)

Referring to Figure 5, reconnect and reclamp the choke cable as follows:

1. Stop the engine and disconnect the spark plugs and, if so equipped, the battery (negative [-] cable).

⚠WARNING *Accidental starting of the engine can result in severe personal injury or death. Always disconnect the spark plug and battery (negative [-] cable) before resetting the engine control cables.*

2. Push the equipment choke knob to the full-open choke position.
3. Connect the choke cable to the choke lever. (The cable will either hook into the choke lever or be clamped by a screw in a swivel on the choke lever. See Figure 5.) Pull the slack out of the cable and clamp it.
4. Check for smooth movement and full travel of the equipment choke knob. Remove the air cleaner element as explained under *Periodic Maintenance* to see that the choke plate opens and closes fully.
6. Reassemble the air cleaner and reconnect the spark plug and battery.

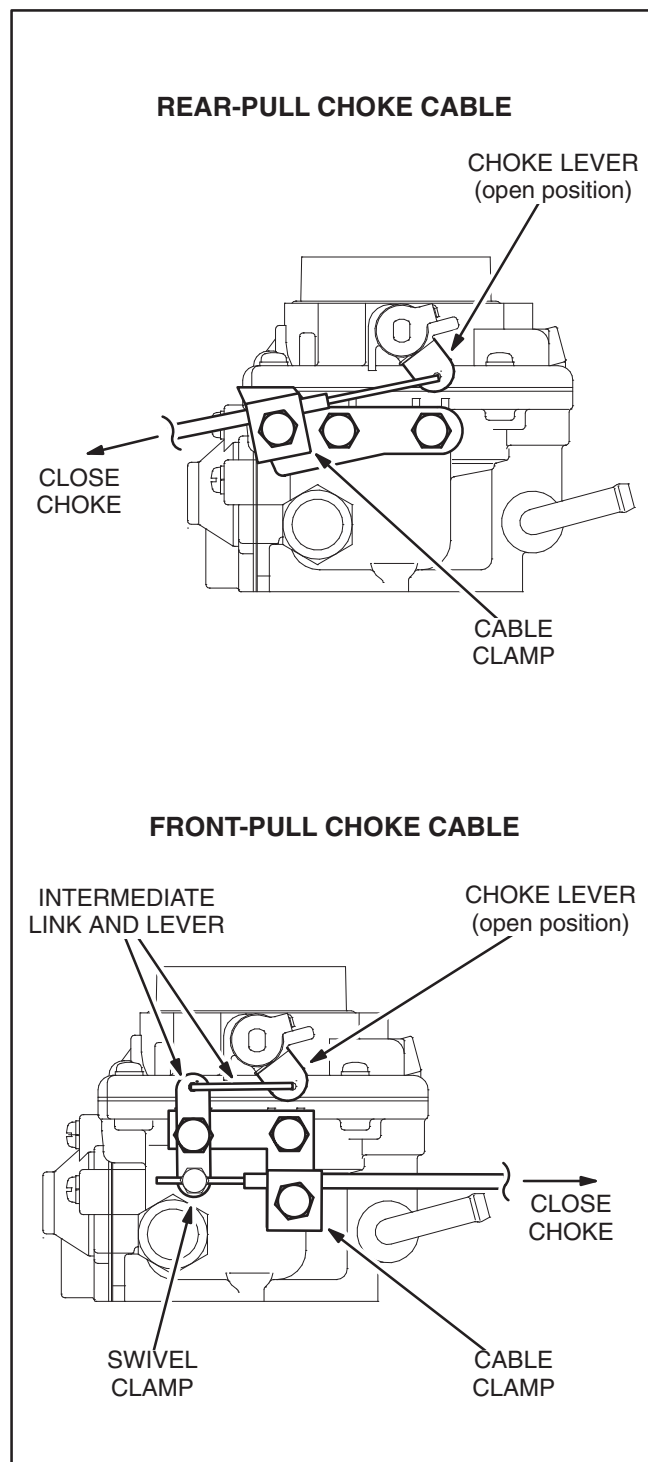


FIGURE 5. FRONT-PULL AND REAR-PULL CHOKE CABLE ARRANGEMENTS

ENGINE SPEED ADJUSTMENT

Normally there is no need to adjust engine speed. These instructions are for the equipment manufacturer in setting up and adjusting the equipment.

Engine speed adjustment must be attempted only by a qualified mechanic and the adjustments must be made using an accurate tachometer. Set the low-idle and high-idle speeds to the values specified in the equipment Operator's Manual. In the absence of such specifications it is recommended that low-idle speed be adjusted to 1,100 RPM and high-idle speed to 3,400 RPM.

⚠WARNING *Adjusting the engine speed to a value above that specified by the equipment manufacture could cause the equipment to operate at speeds in violation of Federal and State Standards for Safety for the equipment.*

⚠WARNING *Moving parts can cause severe personal injury or death. Take care when measuring engine speed with a tachometer and follow the meter instructions. You must be a qualified mechanic.*

Referring to Figure 6, adjust the low-idle and high-idle engine speeds as follows:

1. Start the engine, observing all of the equipment manufacturer's instructions and precautions.
2. If the throttle cable has already been connected, loosen the clamp at the engine and back out the low-idle speed stop screw so that the speed stop screw on the carburetor touches its stop. Adjust engine speed to 1,000 RPM with the carburetor speed stop screw.
3. Turn the low-idle speed stop screw to obtain the specified low-idle speed.
4. Move the engine throttle link up against its stop tang and hold it there while bending the tang as necessary to obtain the specified high-idle speed.
5. Hook the engine throttle link with the throttle cable, pull the slack out of the throttle cable and tighten the clamp. Check for full, smooth movement of the engine throttle link between its two stop positions when the equipment throttle lever is moved through its full range.

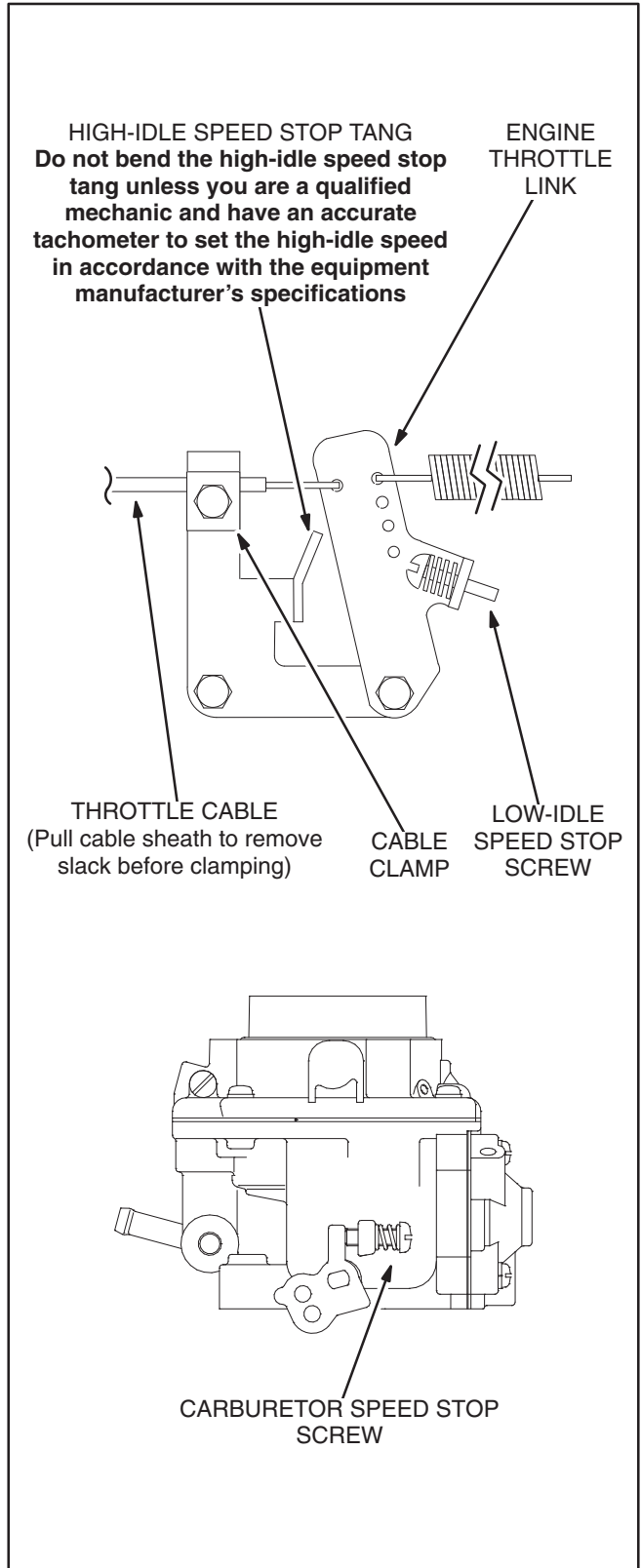


FIGURE 6. SPEED ADJUSTMENTS

Troubleshooting

Table 3 provides basic troubleshooting guidance. If you fail to resolve the problem after taking the corrective actions suggested, contact the equipment or Onan dealer.

sonnel with knowledge of fuels, electricity, and machinery hazards should perform service procedures. Review the safety precautions on the inside cover page.

⚠WARNING Many troubleshooting procedures present hazards that can result in severe personal injury or death. Only qualified service per-

⚠WARNING Hot engine parts can cause severe burns. Always allow the engine time to cool before performing any maintenance or service.

TABLE 3. TROUBLESHOOTING

Problem	Corrective Action
1. The engine fails to crank.	<ul style="list-style-type: none"> a. Release the clutch (if so equipped). b. Clean and tighten the positive (+) and negative (-) battery cable connections at the battery and the engine. c. Recharge the battery. Refer to the equipment or battery manufacturer's recommendations.
2. The engine cranks slowly.	<ul style="list-style-type: none"> a. Release the clutch (if so equipped). b. Clean and tighten the positive (+) and negative (-) battery cable connections at the battery and the engine. c. Recharge the battery. Refer to the equipment or battery manufacturer's recommendations. d. Change engine oil to oil having the proper viscosity for the ambient temperature. See Table 1.
3. The engine cranks but fails to start.	<ul style="list-style-type: none"> a. Check the fuel tank and fill if necessary. b. Open any closed fuel shut off valve. c. Check engine oil level and add oil as necessary. d. Reconnect and reclamp the choke cable (manual chokes only). See <i>Adjustments</i>. e. Service the air cleaner. f. Replace the fuel filter(if provided). g. Replace the spark plugs.
4. The engine runs and then stops.	<ul style="list-style-type: none"> a. Check the fuel tank and fill if necessary. b. Check the engine oil level and add oil as necessary. Drain excess oil if the level is above the dipstick Full mark. c. Reconnect and reclamp the choke cable (manual chokes only). See <i>Adjustments</i>.
5. The engine exhausts black smoke.	<ul style="list-style-type: none"> a. Service the air cleaner. b. Reconnect and reclamp the choke cable (manual chokes only). See <i>Adjustments</i>.
6. The engine misfires.	<ul style="list-style-type: none"> a. Replace the spark plugs.

Specifications

	MODEL P218V	MODEL P220V
Engine Type	Horizontally Opposed 2-Cylinder, 4-Stroke Cycle, Spark-Ignited, Side-Valve, Air-Cooled, Vertical-Shaft	
Bore	3.250 inches (83 mm)	3.250 inches (83 mm)
Stroke	2.875 inches (73 mm)	2.875 inches (73 mm)
Displacement	48 inches ³ (782 cc)	48 inches ³ (782 cc)
Compression Ratio	7.0 : 1	7.0 : 1
Power at Rated Speed (3600 RPM)	18 HP (13.4 kW)	20 HP (14.9 kW)
Oil Capacity (with Filter)*	2 quarts (1.9 l)	2 quarts (1.9 l)
Intake Valve Clearance (Cold)	0.005 inches (0.13 mm)	0.005 inches (0.13 mm)
Exhaust Valve Clearance (Cold)	0.013 inches (0.33 mm)	0.013 inches (0.33 mm)
Spark Plug Gap	0.025 inches (0.64 mm)	0.025 inches (0.64 mm)
Spark Plug Tightening Torque	11 lbs-ft (14 N-m)	11 lbs-ft (14 N-m)
Ignition Timing (Non-adjustable electronic ignition)	20° BTDC	20° BTDC
* –See <i>Periodic Maintenance</i> for oil filling instructions.		

Important Information for California Engine Users

These engines meet the requirements of California's Exhaust Emissions Standards for 1995 and later for Utility and Lawn and Garden Equipment Engines.

As a California user of these engines, please be aware that unauthorized modifications or replacement of fuel, exhaust, air intake, or speed control system components that affect engine emissions are prohibited. Unauthorized modification, removal or replacement of the engine label is prohibited.

You should carefully review Operator (Owner), Installation and other manuals and information you receive with your engine or equipment. If you are unsure that the installation, use, maintenance or service of your engine or equipment is authorized, you should seek assistance from an approved Onan engine dealer or an approved dealer for your equipment.

California engine users may use Tables 4 as aids in locating information related to the California Air Resources Board requirements for emissions control.

TABLE 4. EMISSIONS CONTROL INFORMATION

Engine Warranty Information	The California emissions control warranty statement is located in the same packet of information as this manual when the engine is shipped from the factory.
Engine Valve Lash	See <i>Specifications</i> .
Engine Ignition Timing	See <i>Specifications</i> .
Engine Fuel Requirements	The engine is certified to operate on unleaded gasoline. See Fuel Recommendations in <i>Introduction</i> .
Engine Lubricating Oil Requirements	See Engine Oil Recommendations in <i>Introduction</i> .
Engine Fuel Mixture Settings	These engines have precision-manufactured carburetors which are not adjustable.
Engine Adjustments	See <i>Adjustments</i> .
Engine Emission Control System	The engine emission control system consists of internal engine modifications.



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